Transforming in the Digital Tide: An In-depth Analysis of the Impact of E-Commerce on Brick-and-Mortar Retail in China, 2019-2023

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Background

- **Significant Change**: E-commerce reshapes China's retail landscape.
- **Focus**: Analyzing how e-commerce transforms traditional retail.
- **Analysis**: Examining retail trends, online/offline sales, consumer shifts.
- **Goal**: Detailed, data-driven insights into China's evolving retail sector.
- **China's E-commerce Boom**: From RMB 930 billion (2004) to RMB 29,160 billion (2017); 533 million online shoppers by 2017.
- **Global Dominance**: China's global e-commerce market share soared from under 1% to over 40%.

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Process

Assumption:

- Data Reliability, Consumer Behavior, Representation, Technology Access, Retail Segmentation.

Predictions:

- Market Shift: Growing negative correlation between online and offline retail indicates a shift towards digital platforms.
- COVID-19 Impact: Pandemic accelerates e-commerce adoption, altering consumer behavior.

Data Section Overview:

- **Data Sources:** Primary data from the National Bureau of Statistics of China.
- **Collection Method:** Efficient data gathering using Python-based web scraping tools.
- **Dataset Insights:** Interplay and trends between online and offline retail channels.

Process-Data

Data Crawling with Python:

- Data Extraction: HTTP POST requests for retail data.
- Parsing and Cleaning: Custom functions for JSON parsing.
- Data Structuring: Organizing data in pandas DataFrames.

Data Processing Overview:

- Integration and Summarization: Unifying various datasets.
- Handling Data Shortages: Averaging technique for January data.
- Correlation Analysis: Examining online-offline sales relationship.

Key Considerations in Data Handling:

- Integration of Diverse Data Sources.
- Addressing Seasonal Data Shortages.
- Ensuring Cumulative Data Accuracy.
- Assessing COVID-19's Retail Impact.

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Descriptive Analysis of Retail Sales

Online Sales Trends:

- Monthly sales fluctuate with seasonal peaks.
- An increasing trend observed from 2019 to 2023.
- Data suggests potential seasonal patterns.

Figure: Monthly Online Sales Data

In-Store Sales Patterns:

- Larger fluctuations in sales compared to online.
- Sharp increase at the start of 2020, hinting at a possible event impact or seasonal trend.
- Trends assist in comparing online vs. in-store performance and strategic planning.

Figure: Monthly Offline Sales Data

Trends in In-Store vs. Online Retail Sales:

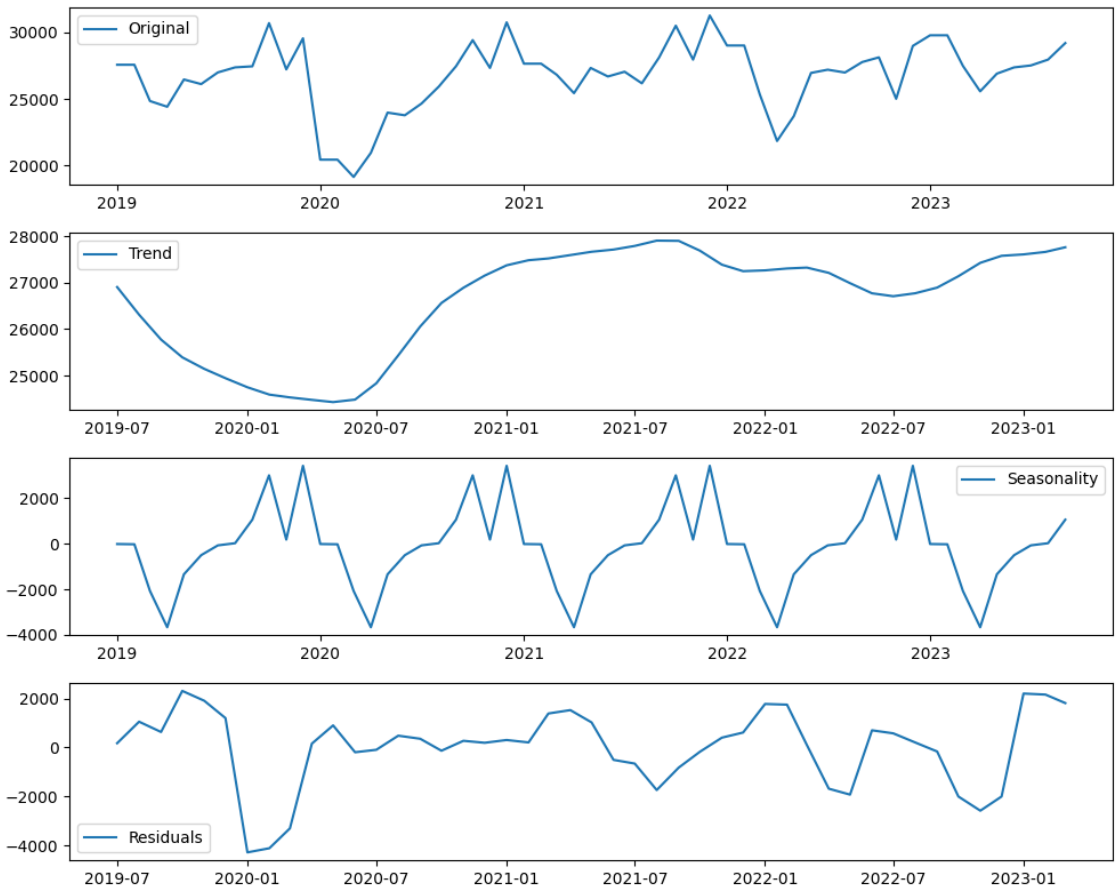
- Online sales are steadily increasing over time.
- In-store sales are more volatile and slightly declining.
- The gap between in-store and online sales is narrowing.

Figure: Online and offline sales compare

Seasonal Analysis in Retail Sales

Offline Trends:

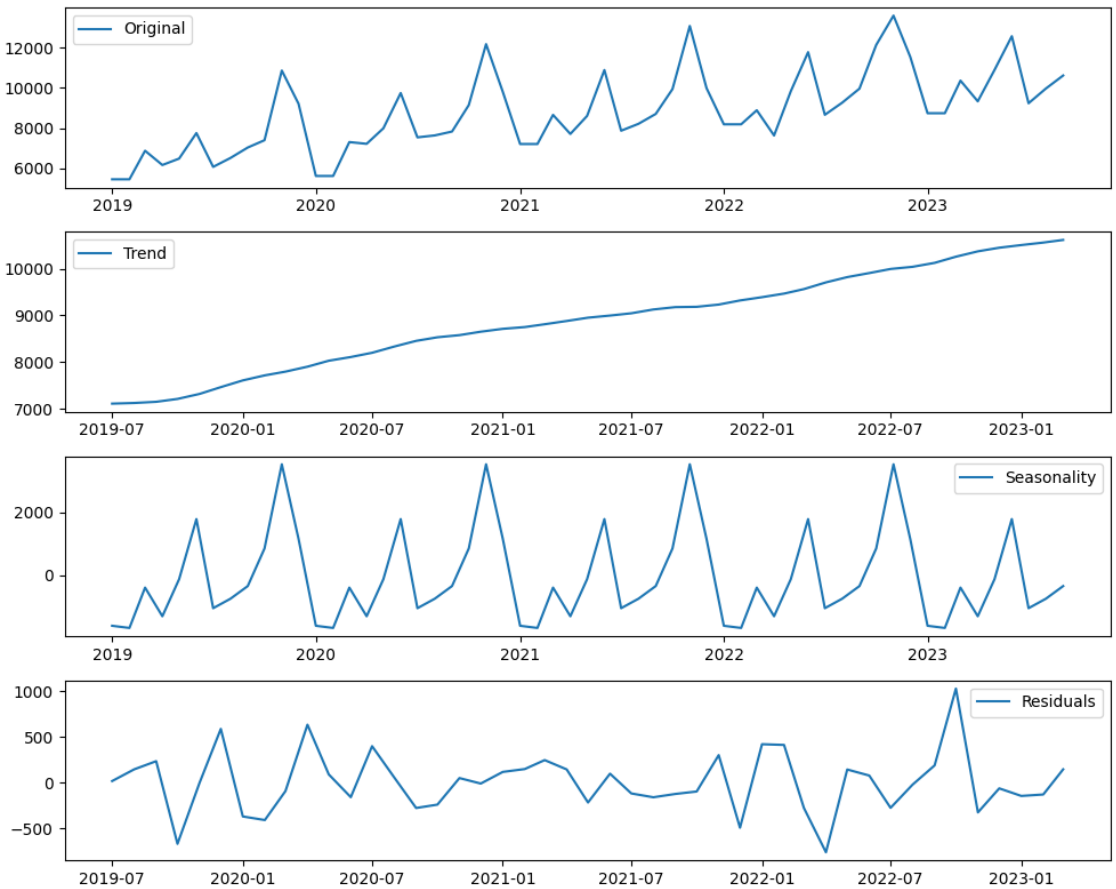
- Fluctuations in physical store sales with seasonal influences.
- Decline in early 2020 due to COVID-19, followed by recovery.
- Seasonality indicates regular sales changes throughout the year.



Seasonal Analysis in Retail Sales

Online Trends:

- Monthly online sales show peaks likely due to promotional events.
- Long-term trend shows consistent growth in online sales.
- Seasonal cycles reflect the impact of holidays and sales events.



T test

- Conduct a t-test on the online monthly sales and offline monthly sales.
- The variances of the two sets of data are considered to be equal.
- There is a significant difference in the means of the two data samples.

Table: Statistical Test Results

Test	**Value**
Levene Statistics	0.6410
p-value (Levene)	0.4250
t Statistics	−41.4779
p-value (t-test)	1.066

Regression analysis

- Statistically significant relationship.
- R-squared value of 0.108, indicating that online sales only modestly predict in-store sales.
- Contrary to expectations that online sales growth would weaken offline sales, both seem to be rising, possibly due to overall economic recovery post-pandemic.

OLS Regression Results

Dep. Variable:	Accumulated Sales	R-squared:	0.108
Model:	OLS	Adj. R-squared:	0.092
Method:	Least Squares	F-statistic:	6.669
Date:	Mon, 04 Dec 2023	Prob (F-statistic):	0.0125
Time:	18:06:07	Log-Likelihood:	-525.45
No. Observations:	57	AIC:	1055.
Df Residuals:	55	BIC:	1059.
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	2.295e+04	1510.843	15.192	0.000	1.99e+04	2.6e+04
Accumulated Sales	0.4333	0.168	2.582	0.013	0.097	0.770

Omnibus:	5.161	Durbin-Watson:	0.967
Prob(Omnibus):	0.076	Jarque-Bera (JB):	4.398
Skew:	-0.669	Prob(JB):	0.111
Kurtosis:	3.253	Cond. No.	4.14e+04

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 4.14e+04. This might indicate that there are strong multicollinearity or other numerical problems.

Figure: Regression analysis

Deseasonalized regression

- R-squared value of 0.162, indicating a stronger predictive power of online sales on in-store sales.
- Suggesting a meaningful relationship between online and deseasonalized in-store sales.

OLS Regression Results

Dep. Variable:	y	R-squared:	0.162
Model:	OLS	Adj. R-squared:	0.142
Method:	Least Squares	F-statistic:	8.292
Date:	Mon, 04 Dec 2023	Prob (F-statistic):	0.00618
Time:	18:12:17	Log-Likelihood:	-404.17
No. Observations:	45	AIC:	812.3
Df Residuals:	43	BIC:	815.9
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	1.966e+04	2436.490	8.070	0.000	1.47e+04	2.46e+04
0	0.7825	0.272	2.880	0.006	0.235	1.331

Omnibus:	7.690	Durbin-Watson:	0.538
Prob(Omnibus):	0.021	Jarque-Bera (JB):	7.036
Skew:	-0.955	Prob(JB):	0.0297
Kurtosis:	3.320	Cond. No.	7.44e+04

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 7.44e+04. This might indicate that there are strong multicollinearity or other numerical problems.

Figure: Deseasonalized regression analysis

Conclusion

- **Data-Driven Approach:** Utilized data from China's National Bureau of Statistics, analyzed via Python-based web scraping, covering the period from 2019 to 2023.
- **Consumer Shift to Digital:** Identified a significant consumer preference shift towards e-commerce platforms.
- **Impact of COVID-19:** Observed an acceleration in e-commerce adoption due to the pandemic, indicating lasting changes in consumer behavior.
- **Seasonal Influence:** Detected the growing importance of seasonality in affecting both online and offline retail sales trends.
- **Synchronized Development:** Found that online and offline retail developments are in sync, contrary to the initial hypothesis that online growth would hinder offline retail.
- **Future of Retail:** Contributed insights crucial for understanding and anticipating the future dynamics of retail in a digital-dominated era.